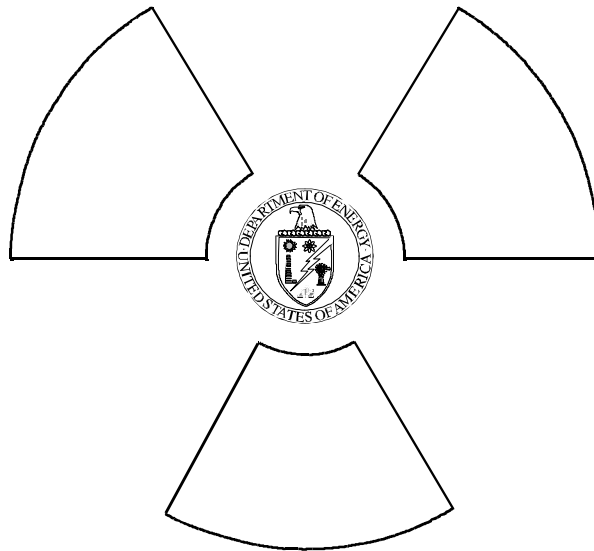


SEALED RADIOACTIVE SOURCE ACCOUNTABILITY AND CONTROL GUIDE

for use with
**Title 10, Code of Federal Regulations, Part 835,
Occupational Radiation Protection**



**Assistant Secretary for Environment,
Safety and Health**

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ACRONYMS

AEC	Atomic Energy Commission
ALARA	as low as is reasonably achievable
ANSI	American National Standards Institute
DOE	U.S. Department of Energy
DOE G	DOE Guide
DOE O	DOE Order
DOE-STD	DOE Standard
ICRP	International Commission on Radiological Protection
ISO	International Organization for Standardization
NCRP	National Council on Radiation Protection and Measurements
NRC	U.S. Nuclear Regulatory Commission
RCO	radiological control organization
RCS	RADIOLOGICAL CONTROL, DOE-STD-1098-99

SEALED RADIOACTIVE SOURCE ACCOUNTABILITY AND CONTROL

1. PURPOSE AND APPLICABILITY

This Guide provides an acceptable methodology for establishing and operating a sealed radioactive source accountability and control program that will comply with U.S. Department of Energy (DOE) requirements specified in Title 10 of the Code of Federal Regulations (CFR), Part 835, Occupational Radiation Protection (DOE 1998a), hereinafter referred to as 10 CFR 835. In particular, this Guide provides guidance for achieving compliance with subpart M of 10 CFR 835. This Guide provides cross-references to other Guides, DOE-STD-1098-99, RADIOLOGICAL CONTROL (DOE 1999a), hereinafter referred to as the RCS, DOE directives, and industry consensus standards that provide detailed guidance for implementing specific requirements in 10 CFR 835. For completeness, this Guide also identifies applicable recommendations contained in secondary documents (International Commission on Radiological Protection (ICRP) Standards, American National Standards (ANSI), etc.).

The regulatory requirements of 10 CFR 835 are enforceable under the provisions of Sections 223© and 234A of the Atomic Energy Act of 1954, as amended (AEC 1954).

Except for requirements established by regulation, contract, or administrative means, the provisions in this Guide are DOE's views on acceptable methods of program implementation and are not mandatory. Conformance with this Guide will, however, create an inference of compliance with the related requirements. Alternate methods that are demonstrated to provide an equivalent or better level of protection are acceptable. DOE encourages its contractors to go beyond the minimum regulatory requirements and to pursue excellence in their programs.

The word "shall" is used in this Guide to designate requirements from 10 CFR 835. Compliance with 10 CFR 835 is mandatory except to the extent an exemption has been granted pursuant to 10 CFR 820, Procedural Rules for DOE Nuclear Activities (DOE 1993). The words "should" and "may" are used to represent optional program recommendations and allowable alternatives, respectively.

This Guide is applicable to all DOE activities that are subject to the requirements of 10 CFR 835.

2. DEFINITIONS

Terms defined in 10 CFR 835 are used in this Guide consistent with their regulatory definitions.

Exempt sealed radioactive source: A sealed radioactive source that does not meet the accountability criteria established in the definition of the term “accountable sealed radioactive source” provided in 10 CFR 835.2(a).

Radiological control organization (RCO): An organization responsible for radiation protection activities.

Source custodian: An individual who is trained and designated to maintain cognizance over accountability and control of assigned sealed radioactive sources.

Source user: An individual who is trained and authorized to use sealed radioactive sources.

3. DISCUSSION

A program to control sealed radioactive sources is necessary to prevent unplanned exposures and loss of sources. DOE has codified a general requirement indicating that all sealed radioactive sources (both accountable and exempt) shall be used, handled, and stored in a manner commensurate with the hazards associated with operations involving the sources (10 CFR 835.1201). For accountable sealed radioactive sources, specific measures, including inventories and source leak tests, shall be implemented (10 CFR 835.1202).

Exempt sealed radioactive sources need not be inventoried and leak tested. However, exempt sealed radioactive sources and the individuals using them are still subject to all other applicable requirements of 10 CFR 835 (e.g., radioactive material control, posting and labeling, radiation safety training, etc).

If a sealed radioactive source contains more than one radionuclide, the sum-of-the-fractions rule (i.e., $\sum A_i/Q_i + A_2/Q_2 + \dots \geq 1$; where A is source activity and Q is the accountability value for the radionuclide) shall be used to determine if the source is accountable (10 CFR 835, Appendix E, Footnote 1). For radionuclides that are not listed in Appendix E, 10 CFR 835 provides values of 10 microcuries for alpha emitters and 100 microcuries for all other radionuclides. The values provided in Appendix E of 10 CFR 835 are not material release values and should not be used to determine the acceptability of releasing materials from radiological controls either within or outside of the controlled area.

10 CFR 835.3(e) establishes provisions allowing for extensions of the intervals between mandatory sealed radioactive source inventories and source leak tests. DOE G 441.1-1, MANAGEMENT AND ADMINISTRATION OF RADIATION PROTECTION PROGRAMS GUIDE (DOE 1999b), provides guidance for implementing necessary extensions of the required intervals.

4. IMPLEMENTATION GUIDANCE

This section provides guidance for establishing and operating a sealed radioactive source accountability and control program. Key components of a sealed radioactive source accountability and control program should include:

- organization and responsibilities;
- receipt;
- labeling and storage;
- inventory;
- source leak testing; and
- handling and disposal.

Responsibilities of the organizational components, including line management, the radiological control organization (hereinafter referred to as the RCO), the source custodian, and the source user are presented.

4.1 ORGANIZATION AND RESPONSIBILITIES

The responsibilities of the RCO for a sealed radioactive source accountability and control program should include the following:

- establishing the program;
- maintaining records related to the accountability and control of sealed radioactive sources;
- providing each source custodian with an inventory list of accountable sealed radioactive sources; and
- assisting the source custodian in training source users.

Some of these responsibilities may be delegated to another contractor group, for example, the safeguards and security group may be given the responsibility for maintaining accountability records. Non-delegatable responsibilities of the RCO should include:

- coordinating procurement of all sealed radioactive sources with the source custodian or user;
- performing receipt monitoring;
- performing source leak tests; and
- monitoring storage and use areas.

Sealed radioactive source custodians and source users are generally expected to work directly with radioactive materials and therefore would meet the 10 CFR 835.2(a) definition of the term “radiological worker.” Such individuals would therefore be subject to the radiation safety training requirements of 10 CFR 835.901(b). An individual shall be trained in accordance with 10 CFR 835.901(b) prior to performing unescorted assignments as a radiological worker. 10 CFR 835.103 establishes additional requirements for the education, training, and skills of those individuals who are responsible for developing and implementing measures necessary for ensuring regulatory compliance. That training should include site-specific source accountability and control measures discussed in this Guide. See DOE G 441.1-12, RADIATION SAFETY TRAINING GUIDE (DOE 1999c) and DOE G 441.1-1 for additional guidance.

The source custodian should notify and obtain approval of the RCO prior to:

- any major changes in the use of a sealed radioactive source;
- transfer of a sealed radioactive source to a new permanent storage location or to a new source custodian;
- modification of a device containing a sealed radioactive source;
- disposal or off-site transfer of a sealed radioactive source; and
- any procurement or acquisition of additional sealed radioactive sources.

The source custodian should notify the RCO in the event of the loss of, or suspected or actual damage to, any sealed radioactive source. The source custodian should ensure that source leak tests are conducted and inventory checks are performed for accountable sealed radioactive sources at least every 6 months. The RCO should actually perform the source leak tests. The source custodian should maintain records of the storage and use locations of all assigned sealed radioactive sources.

Prior to taking possession of the sealed radioactive source, the source user should receive authorization from the RCO and the source custodian. Source users should use, handle, and store assigned sealed radioactive sources consistent with the training provided and in accordance with the programmatic requirements established by the RCO.

4.2 RECEIPT

Prior to receipt sealed radioactive sources, the RCO should assign the sources to the proper source custodians. Immediately upon receipt of sealed radioactive sources, the RCO should be notified. The packaging shall be inspected for damage and contamination and radiation monitoring performed in accordance with 10 CFR 835.405. Except for gaseous sealed radioactive sources and tritium, a source leak test shall be performed upon receipt of all accountable sealed radioactive sources (10 CFR 835.1202(b)). The receipt monitoring and source leak test should be performed by the RCO. The source leak test should be performed in accordance with Section IV.E. of this Guide. The source custodian should be notified of the arrival of the sealed radioactive sources to ensure that proper accountability and controls are initiated. The sources should be placed into storage or into the device in which they will be used. The source custodian's and site's records should be updated to include the new sealed radioactive sources.

4.3 LABELING AND STORAGE

Unless specifically excepted under 10 CFR 835.606, all sealed radioactive sources having an activity exceeding 10% of the applicable 10 CFR 835 Appendix E values shall be labeled (10 CFR 835.605). Labels should be applied to all sealed radioactive sources, regardless of the activity of the source, to minimize the likelihood of loss or unauthorized usage. In recognition of the differing labels permanently applied to certain sealed radioactive sources by their manufacturers, labels applied to sealed radioactive sources may be excepted from the color specifications of 10 CFR 835.601(a) (10 CFR 835.606(b)(6)). However, standard colors and designs should be used to the extent practicable to foster instant recognition by affected individuals.

Appropriate designs for radioactive material labels applied to sealed radioactive sources are described in Guide DOE G 441.1-10, POSTING AND LABELING FOR RADIOLOGICAL CONTROL GUIDE (DOE 1999d). Labels should be applied directly to the sealed radioactive source or, if that is not practicable, the labels should be applied to the storage containers and devices containing sealed radioactive sources. The label should identify the radionuclide, source activity, date of assay, model and serial number of the source and container or device, and a method for identifying the source custodian.

In addition, labels should include the contact radiation levels, removable contamination levels, dates monitored, and name of the individual performing the monitoring. The label should be sufficiently durable to remain legible for the useful life of the device or storage container and should be located in a readily visible place.

Ideally, all the labeling information should be on a label affixed to the source; however, due to the extensive list of information and the small size of many sealed radioactive sources, this is not always possible. If the source is too small to label, then either its source container (unless it is also too small) or its radioactive material storage location should be labeled. A method of tracing a source to its label should be implemented if the label is affixed to the source container or radioactive material storage location. Commercially manufactured sources should have a serial number on the source itself which should be traceable to the serial number on the label. For sources without serial numbers, the contractor should permanently mark the source, such that the integrity of the source is not violated, with a unique identification, and should use the same identification mark on the label.

If the radiation intensity around the sealed radioactive source container will change significantly upon opening the container or changing the position of the source in the container, that information should be provided on a label so that it is easily observable by the operator.

The storage location should also be marked in order to ease location identification during inventory. Storage locations, containers, and devices should be appropriate for the specific sources, and should only be used to contain radioactive materials. Storage rooms or cabinets selected to contain accountable sealed radioactive sources should either be isolated from occupied areas or located in radiological areas, be of a design which would minimize damage from fire, and be free of flammable or combustible substances. Storage rooms or cabinets containing sealed radioactive sources should be locked, monitored routinely, and posted.

Radiation and contamination monitoring of the sealed radioactive source storage area or facility should be performed before its initial use and periodically thereafter. Monitoring shall be performed whenever changes in status (e.g., receipt of a new sealed radioactive source, modification to shielding) are made that may significantly affect radiological conditions (10 CFR 835.401(a)(3)).

Proper storage practices should be used to limit unauthorized use of a sealed radioactive source and to minimize the potential for sealed radioactive source rupture, excessive personnel exposure, or loss of the sealed radioactive source.

4.4 INVENTORY

Except for certain circumstances discussed below, all accountable sealed radioactive sources shall be inventoried at intervals not to exceed six months. These inventories shall accomplish the following:

- establish the physical location of each source;
- verify the presence and adequacy of associated postings and labels; and
- establish the adequacy of storage locations, containers, and devices (10 CFR 835.1202(a)).

The presence and adequacy of postings and labels and adequacy of storage locations may be assured through verification that these features have been established and maintained consistent with the guidance provided in this Guide. Upon determination that an accountable sealed radioactive source has been lost or is not stored, posted, and labeled consistent with 10 CFR 835, the RCO should be notified.

Although exempt sealed radioactive sources are not required to be inventoried, steps should be taken to prevent the loss of these sources, regardless of activity, as required by 10 CFR 835.1201. Measures should be implemented to restrict the removal of sources from specified locations and, when sources are moved, to administratively track source locations.

Appendices A and B are examples of typical accountable sealed radioactive source accountability forms. A form similar to Appendix A should be completed for each new source. This form should cover initial receipt and registration of the source, changes in source status (e.g., disposal, new use, failure of a leak test), custodian information, and initial/receipt leak testing information. As changes occur in the source status or the source custodian, applicable portions of the form should be updated as necessary. For example, if the source is transferred, that portion of the form should be revised by the source custodian and the updated form sent to the responsible RCO.

The site organization responsible for sealed radioactive source accountability (i.e., the RCO or delegated organization) should maintain an individual form similar to the one in Appendix A for each accountable sealed radioactive source at each facility. Each source custodian should also maintain a form for each accountable sealed radioactive source under their responsibility.

A form similar to the one in Appendix B should be provided to the source custodian when inventory checks and/or leak tests are scheduled. This form should be completed and a copy sent to the responsible RCO to update the accountability records. It is recommended that the source custodian schedule the conduct of the periodic leak tests for all of the sealed radioactive sources under his or her responsibility. The inventories may be done by the source custodian or the RCO (at the time of the leak testing).

Most accountable sealed radioactive sources are used in a location near their radioactive material storage location. Some portable survey instruments and fixed-location detection systems have check sources with activities high

enough to classify them as accountable sealed radioactive sources. The source custodian is not required to know the exact location of each check source affixed to a portable survey instrument because radiological control technicians frequently carry such instruments from facility to facility. Notifying the source custodian each time a portable survey instrument with an accountable check source is moved is not required. Therefore, the source custodian for check sources in portable survey instruments and fixed-location detection systems should be an individual in the calibration facility who can perform the inventory check and get the leak test performed.

Similarly, notification of the RCO should not be required for the movement of any accountable sealed radioactive source as long as it is being used according to approved operations (e.g., according to a procedure or radiological work permit) as long as the source will be returned to its original storage location.

4.5 LEAK TESTING

Except for those sources consisting solely of gaseous radioactive material or tritium, accountable sealed radioactive sources shall undergo a source leak test upon receipt, when damage is suspected, and at least every six months (10 CFR 835.1202(b)). A leak test should be performed prior to initial use of an accountable sealed radioactive source and when any measurable contamination is detected on handling or storage equipment (unless the contamination is known to be from another source).

The integrity of an accountable sealed radioactive source should be established by a wipe test or other leak test method as recommended in ISO/DIS Report 9978, *Radiation Protection Sealed Radioactive Sources Leakage Test Methods* (ISO 1990); ISO/TR Report 4826, *Sealed Radioactive Sources - Leak Test Methods* (ISO 1979); ISO Report 1677, *Sealed Radioactive Sources - General* (ISO 1977); NCRP Report No. 40, *Protection Against Radiation from Brachytherapy Sources* (NCRP 1972); and ANSI N43.6-1977, *Sealed Radioactive Sources, Classification* (ANSI 1977). Appendix V of NUREG-1556, Volume 11, *Consolidated Guidance About Materials Licenses* (NRC 1998), provides an acceptable procedure for performing source leak tests.

Electroplated sources should not be tested for leakage by wiping the foil directly. An indication of leakage can be obtained by checking the storage container for radioactivity or by checking the exhaust ports of items such as gas chromatography devices (ICRP 1977). The integrity of an accountable sealed radioactive source contained within a shield or device may be checked by wiping the area where contamination is most likely to occur from a failure of source integrity. If it is necessary to provide direct access to such a source to perform an adequate leak test, then appropriate controls should be established in accordance with 10 CFR 835, the RCS, and the manufacturer's directions. Due to the high whole body or extremity doses that can result, leak tests on high activity sources should never be performed by direct contact. Remote handling devices or indirect monitoring techniques, such as monitoring of exhaust ports or accessible areas likely to be contaminated by a leaking source, should be used.

If analysis of the leak test sample (e.g., smear) indicates that the sample has removed less than 0.005 microcurie (185 Bq) from the area wiped, then the leakage may be considered to be less than the 10 CFR 835.1202(b) maximum leakage criterion of 0.005 microcurie (185 Bq).

An accountable sealed radioactive source is not subject to periodic source leak testing if that source has been removed from service. However, unless leak testing is precluded by other radiological safety considerations, these sources should be leak tested periodically to determine the condition of the source. Such sources shall be stored in a controlled location, subject to periodic inventory, and subject to source leak testing prior to being returned to service (10 CFR 835.1202(c)). Additionally, a documented and updated accountable sealed radioactive source

form similar to Appendix A should be maintained for each accountable sealed radioactive source, recording the last known leak test.

An accountable sealed radioactive source is not subject to periodic inventory and source leak testing if that source is located in an area that is unsafe for human entry or otherwise inaccessible, e.g., oxygen deficient or very high radiation areas (10 CFR 835.1202(d)). If a source is removed from the unsafe area or otherwise becomes accessible, then this exception would no longer apply. This provision is not applicable to sources that are located in instruments or other devices located in accessible areas, nor should it be applied to sources that may be considered inaccessible due to radiological conditions created by the presence of the source itself; leak tests may be performed on these sources by wiping the instrument or device consistent with the guidance provided above. If a source is determined to be inaccessible for inventory and source leak testing, then appropriate measures should be implemented to control access to the affected area and to monitor for the presence of contamination that may be spread as a result of source failure (See DOE G 441.1-9, RADIOACTIVE CONTAMINATION CONTROL GUIDE (DOE 1999e)). When the conditions that resulted in the area being inaccessible have been eliminated, the required inventories and source leak tests should be completed prior to rescinding these measures.

The source custodian should be responsible for ensuring that source leak tests of accountable sealed radioactive sources are conducted at least every six months. If a sealed radioactive source cannot be leak tested at the proper time, the source should be removed from service until the leak test is performed. If a source is installed in an inaccessible area, the device should not be used until the source has been leak tested.

A test result that reveals the presence of removable radioactivity on the non-radioactive surfaces is an indication that the sealed radioactive source has lost its integrity. The leaking source shall be controlled in a manner that minimizes the spread of radioactive contamination (10 CFR 835.1202(e)). Any sealed radioactive source that fails a leak test should be immediately removed from service and controlled in accordance with contamination control practices defined in 10 CFR 835. The source should be placed in a separate container to prevent the spread of contamination. All personnel and equipment that were in contact with the leaking source should be checked for contamination; this includes transportation vehicles and the work site. The source custodian, working with the RCO, should either return the leaking source to the manufacturer or send it to other qualified personnel for repair or disposal. Refer to DOE G 441.1-9 for additional guidance.

4.6 HANDLING AND DISPOSAL

Certain sealed radioactive sources may create significant localized radiation fields under both normal and abnormal operating conditions. Receipt, storage, use, and disposal of sealed radioactive sources should be conducted in accordance with 10 CFR 835, applicable DOE Orders, consensus standards, and the guidance provided in the following Guides:

- For specific guidance on maintenance of records, see DOE G 441.1-11, OCCUPATIONAL RADIATION PROTECTION RECORD-KEEPING AND REPORTING GUIDE (DOE 1999f);
- For ALARA practices, see DOE G 441.1-2, OCCUPATIONAL ALARA PROGRAM GUIDE (DOE 1999g);
- For posting and labeling practices, see DOE G 441.1-10, POSTING AND LABELING FOR RADIOLOGICAL CONTROL GUIDE;

- For specific guidance regarding external dosimetry considerations, see DOE G 441.1-4, EXTERNAL DOSIMETRY PROGRAM GUIDE (DOE 1999h); and
- For specific contamination controls that should be considered for leaking sealed radioactive sources, see DOE G 441.1-9, RADIOACTIVE CONTAMINATION CONTROL GUIDE.

Off-site sealed radioactive sources, including radiography sources, should not be brought on-site by external organizations without the prior written approval of the RCO.

Radiation protection precautions, dose reduction methods, and special dosimetry and monitoring requirements should be specifically identified in procedures for use of accountable sealed radioactive sources capable of generating external radiation fields in excess of 100 millirem/hour (1 mSv/hour) at 30 cm. Radiation monitoring should be performed during and after use of such sources to verify the adequacy of controls, posting of immediate and adjacent areas, and return of the source to a safe condition

Immediately upon determination of the loss of a sealed radioactive source, the user should notify the source custodian who in turn should notify the RCO. A formal search of all designated use locations, likely transfer paths, and possible collection points for the source should be performed. In addition, an investigation should be conducted by facility management to determine the root cause of the loss.

Obsolete, excess, or leaking sealed radioactive sources should be disposed of according to RCO instructions.

5. REFERENCES

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DOE 1999e. DOE G 441.1-9. RADIOACTIVE CONTAMINATION CONTROL GUIDE, under development at time of publication. Washington, D.C.

DOE 1999f. DOE G 441.1-11. OCCUPATIONAL RADIATION PROTECTION RECORD-KEEPING AND REPORTING GUIDE, under development at time of publication. Washington, D.C.

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DOE 1999h. DOE G 441.1-4. EXTERNAL DOSIMETRY PROGRAM GUIDE, dated 3-17-99. Washington, D.C.

ICRP (International Commission on Radiological Protection) 1977. *The Handling, Storage, Use and Disposal of Unsealed Radionuclides in Hospitals and Medical Research Facilities*. ICRP Publication 25. Oxford, England.

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NRC (U.S. Nuclear Regulatory Commission) 1998. *Consolidated Guidance About Materials Licenses*. NUREG-1556, Volume 11. Washington, D.C.

APPENDIX A
EXAMPLE INDIVIDUAL ACCOUNTABLE
SEALED RADIOACTIVE SOURCE FORM

Individual Accountable Sealed Radioactive Source Form

SOURCE DESCRIPTION

Source Model and Serial Number: _____

Manufacturer: _____

Radionuclide(s): _____ Radiation Type: _____

Chemical Formula: _____ Physical Form: _____

Original Activity: _____ Date of Original Assay: _____

Physical Description: _____

Radiation Reading at Reference Distance: _____

SOURCE STATUS

Date of Receipt: _____ Date of Update: _____

Status Change: ☐ Active - in use ☐ Source integrity failed ☐ New Source - Initial Entry

☐ Lost ☐ In storage ☐ Awaiting disposal ☐ Transferred to new location

☐ Disposed ☐ Returned to manuf. ☐ Decayed below accountability threshold

SHIPPING RECORDS (if transferred to off-site location)

Shipping Order Number: _____

Shipping Organization: _____

Individual Receiving Source: _____

SOURCE CUSTODIAN

Custodian's Name: _____ Badge Number: _____

Mailing Address: _____ Phone Number: _____

SOURCE LOCATION

Facility: _____ Room: _____

Location Within Room: _____

Device Model and Serial Number: _____

INITIAL/RECEIPT LEAK TEST

Date of Test: _____

Type of Instrument Used: _____ Instrument ID Number: _____

Surveyor's Name and Badge Number: _____

Test Results: _____

APPENDIX B
EXAMPLE SEALED RADIOACTIVE
SOURCE ACCOUNTABILITY FORM

Sealed Radioactive Source Accountability Form

Date: _____ Surveyor's Name and Badge Number (Print): _____

Instrument Type	Identification Number	Date Calibrated	Minimum Detectable Activity	Background (cpm)
A.				
B.				
C.				

Source Model & Serial Number	Radionuclide & Activity	Date of Last Leak Test	Instrument(s) Used	Total Counts	Net Counts	Net Activity	Posting / Labeling Check

Signature: _____

**UNITED STATES
DEPARTMENT OF ENERGY**

Office of Worker Protection Programs and Hazards Management (EH-52/270CC)
19901 Germantown Road, Germantown, MD 20874-1290

Request for Changes to
SEALED RADIOACTIVE SOURCE
ACCOUNTABILITY AND CONTROL GUIDE

(Use multiple pages as necessary.)

Page No. _____

Facility Requesting Change _____

Section No. _____

Contact Person _____

Paragraph No. _____

Telephone No. - Fax No. _____

Description of Change Request:

Suggested Specific Word Changes:

EH-52 Technical Staff Contact:

Judith D. Foulke
301-903-5865

EH-52 Guidance Program Contact:

Joel L. Rabovsky
301-903-2135